



# UNITED STATES PATENT AND TRADEMARK OFFICE

A

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/804,366	03/19/2004	Kyle K. Kirby	2269-6208US (03-0852.00/U)	9222
24247	7590	03/10/2006	EXAMINER PHAM, THANHHA S	
TRASK BRITT P.O. BOX 2550 SALT LAKE CITY, UT 84110			ART UNIT 2813	PAPER NUMBER

DATE MAILED: 03/10/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

10/804,366

Applicant(s)

KIRBY ET AL.

Examiner

Thanhha Pham

Art Unit

2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 15 December 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-65 is/are pending in the application.
- 4a) Of the above claim(s) 1-9 and 29-44 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 10-28 and 45-66 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                        | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948)                | Paper No(s)/Mail Date. _____  |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>3/19/2004</u> .   | 6) <input type="checkbox"/> Other: _____                                    |

## **DETAILED ACTION**

This Office Action is in response to Applicant's Response to Restriction and Election of Species Requirements on 12/16/2005.

### ***Election/Restrictions***

1. Claims 1-9 and 29-44 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to nonelected inventions. Election was made **without** traverse in the reply filed on 12/16/2006.
2. Applicant's election without traverse of claims 10-28 and 45-66 in the reply filed on 12/16/2005 is acknowledged.

### ***Oath/Declaration***

3. Oath/Declaration filed on 03/19/2004 has been considered.

### ***Specification***

4. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

Art Unit: 2813

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

**5. Claims 18-19, 55, 64 and 67 are rejected under 35 U.S.C. 102(b) as being anticipated by Mashino [US 2003/0073299].**

► With respect to claims 18-19 and 21, Mashino (figs 1-9, text [0001]-[0061])

discloses the claimed method of removing a heat-affected zone ("HAZ") on a semiconductor substrate, comprising:

forming a HAZ (22/22a, figs 1D-1G, text [0036]-[0039]) in a silicon substrate (10), wherein forming the HAZ in the silicon substrate comprises forming the HAZ by laser ablation [*claims 18, 19*]; and

removing the HAZ without removing at least one of a metal layer, an oxide layer, a nitride layer, and a polyimide layer (12/14, fig 1F-1G, text [0041]) present on the silicon substrate (10) [*claim 18*].

► With respect to claim 55 and 67, Mashino (figs 1-9, text [0001]-[0061]) discloses the claimed method of forming a through-wafer interconnect, comprising:

exposing a silicon substrate (10, figs 1D-1F, text [0037]-[0039]) to a laser beam to form an aperture (20), wherein the laser beam forms a heat-affected zone ("HAZ") (22, 22a) on the silicon substrate;

removing the HAZ without removing at least one of a metal layer, an oxide layer, a nitride layer, and a polyimide layer (12/14, fig 1G, text [0041]) present on the silicon substrate;

forming a passivation layer (14a, fig 1H, text [0042]) on sidewalls of the aperture (20) before filling the aperture with a conductive material (32a/ 32); and

filling the aperture with a conductive material (32a/ 32, fig 1J, text [0042], to form a through-wafer interconnect.

► With respect to claim 64, the "second" etch solution of KOH of Mashino (text [0041]) would inherently remove at least a portion of the silicon substrate to enlarge a diameter of the aperture (20).

**6. Claims 10-13 are rejected under 35 U.S.C. 102 (e) as being anticipated by Brask et al [US 6,927,146].**

► Brask et al (fig 2's, cols 1-12) discloses the claimed method of selectively etching silicon, comprising:

exposing a silicon layer (300, fig 2A) on a semiconductor substrate (100) to an etch solution comprising a tetramethylammonium hydroxide ("TMAH") and at least one organic solvent (isopropyl alcohol, col 5-6), the at least one organic solvent (alcohol) comprises at least one hydroxyl group, the at least one organic solvent having at least one hydroxyl group that dissociates and forms at least one hydroxyl ion (alcohol dissociates and form at least hydroxyl ion); [claims 10-13] and

removing the silicon layer (300, figs 2A-2B) without removing at least one of a

Art Unit: 2813

metal layer, an oxide layer, a nitride layer, and a polyimide layer (200) also present on the semiconductor substrate.

**7. Claims 10-14, 18-25, 45-49 and 54 are rejected under 35 U.S.C. 102(e) as being anticipated by Watkins et al [US 2005/0077913].**

► With respect to claims 10-14, Watkins et al (figs 1-8, text [0001]-[0048]) discloses the claimed method of selectively etching solution comprising:

exposing a silicon layer (10, figs 2E-2F, text [0037]) on a semiconductor substrate (10) to an etch solution comprising a tetramethylammonium hydroxide ("TMAH") and at least one organic solvent (propylene glycol), the at least one organic solvent (propylene glycol) comprises at least one hydroxyl group, the at least one organic solvent having at least one hydroxyl group (propylene glycol) that dissociates and forms at least one hydroxyl ion (propylene glycol dissociates and form at least hydroxyl ion); [claims 10-14] and

removing the silicon layer (10, figs 2E-2F) without removing at least one of a metal layer, an oxide layer, a nitride layer, and a polyimide layer (30) also present on the semiconductor substrate.

► With respect to claims 18-25, Watkins et al (figs 1-8, text [0001]-[0048]) discloses the claimed method of removing a heat-affected zone ("HAZ") on a semiconductor substrate, comprising:

forming a HAZ (fig 2E, text [0036] & [0028]) in a silicon substrate (10), wherein forming the HAZ in the silicon substrate comprises forming the HAZ by laser ablation [claims 18, 19];

removing the HAZ without removing at least one of a metal layer, an oxide layer, a nitride layer, and a polyimide layer (30, fig 2E-2F, text [0028]-[0037]) present on the silicon substrate (10), wherein removing the HAZ without removing the at least one of a metal layer, an oxide layer, a nitride layer and the polyimide layer comprising exposing the silicon substrate to an etch solution comprising a tetramethylammonium hydroxide ("TMAH") and at least one organic solvent (propylene glycol), the at least one organic solvent (propylene glycol) comprises at least one hydroxyl group, the at least one organic solvent having at least one hydroxyl group (propylene glycol) that dissociates and forms at least one hydroxyl ion (propylene glycol dissociates and form at least hydroxyl ion) *[claims 18, 20-25]*; and

removing at least a portion of the silicon substrate other than within the HAZ with the etch solution (figs 2E-2F) *[claims 18 & 21]*

► With respect to claims 45-49, 53-60, and 64, Watkins et al (figs 1-8, text [0001]-[0048]) discloses the claimed method of forming an aperture in a through-wafer interconnect comprising:

exposing a silicon substrate (10, fig 2E, text [0036] & [0028]) to a laser beam (16) to form an aperture, wherein the laser beam forms a heat-affected zone (HAZ) on to silicon substrate;

exposing the silicon substrate to an etch solution comprising tetramethylammonium hydroxide (TMAH) and at least one organic solvent, the at least one organic solvent (propylene glycol) comprises at least one hydroxyl group, the at least one organic

solvent having at least one hydroxyl group (propylene glycol) that dissociates and forms at least one hydroxyl ion (propylene glycol dissociates and form at least hydroxyl ion);

removing the HAZ without removing at least one of a metal layer, an oxide layer, a nitride layer, and a polyimide layer (30, fig 2E-2F, text [0028]-[0037]) present on the silicon substrate (10);

removing the silicon substrate with the etch solution (TMAH and propylene glycol) to enlarge a diameter of the aperture (figs 2E-2F); and

filling the aperture with a conductive material (50, fig 3, text [0038]) to form a through-wafer interconnect.

**8. Claims 18-19, 55, 64 and 67 are rejected under 35 U.S.C. 102(e) as being anticipated by Farnworth et al [US 2004/0256734].**

► With respect to claims 18-19, Farnworth et al (figs 3's, text [0001]-[0202]) discloses the claimed method of removing a heat-affected zone ("HAZ") on a semiconductor substrate, comprising:

forming a HAZ (fig 3E, text [0087] & [0090]) in a silicon substrate (64), wherein forming the HAZ in the silicon substrate comprises forming the HAZ by laser ablation **[claims 18, 19];**

removing the HAZ without removing at least one of a metal layer, an oxide layer, a nitride layer, and a polyimide layer (56/28, fig 3G, text [0037]-[0028]) present on the silicon substrate (64) **[claim 18].**

► With respect to claims 55, 64 and 67, Farnworth et al (figs 3's, text [0001]-[0202]) discloses the claimed method of forming a through-wafer interconnect, comprising:



Art Unit: 2813

exposing a silicon substrate (54, figs 3E, text [0086] - [0090]) to a laser beam to form an aperture (78), wherein the laser beam forms a heat-affected zone ("HAZ") on the silicon substrate *[claim 55]*;

removing the HAZ without removing at least one of a metal layer, an oxide layer, a nitride layer, and a polyimide layer (56/28, fig 3F-3G, text [0090]) present on the silicon substrate *[claim 55]*;

removing at least a portion of the silicon substrate with a second etch solution to enlarge a diameter of the aperture (78, text [0090]) *[claim 64]*

forming a passivation layer (80, fig 3H, text [0091]) on sidewalls of the aperture (78) before filling the aperture with a conductive material *[claim 67]*; and

filling the aperture with the conductive material (26, fig 3K) to form a through-wafer interconnect *[claim 55]*.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**9. Claims 14-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brask et al [US 6,927,146] in view Sachem Spec Sheet 379, as submitted by IDS.**

Brask et al substantially discloses the claimed method including using TMAH in organic solvent. Brask et al does not expressly teach using the etch solution comprising approximate 6%TMAH and approximate 94% propylene glycol for etching silicon. However, selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig-saw puzzle." 325 U.S. at 335, 65 USPQ at 301. See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960) (selection of a known plastic to make a container of a type made of plastics prior to the invention was held to be obvious). It would have been obvious for those skilled in the art to use the claimed etch solution as taught by SaChem in the process of Brask et al as a known etchant for removing silicon.

**10. Claims 15-17, 26-28, 50-52, and 61-63 rejected under 35 U.S.C. 103(a) as being unpatentable over Watkins et al [US 2005/0077913] in view Sachem Spec Sheet 379, as submitted by IDS.**

► With respect to claims 15-17, 26-28, 50-52, and 61-63, the claimed range percentage of TMAH and propylene glycol are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted in *In re Aller* 105 USPQ233, 255 (CCPA 1955), the selection of reaction parameters such as temperature and concentration would have been obvious.

"Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may be impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed "critical ranges and the applicant has the burden of proving such criticality... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."

*See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmischer 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).*

**11. Claims 10-17, 20-28, 45-54, 56-63 are rejected under 35 U.S.C. 103(a) as being unpatentable over Farnworth et al [US 2004/0256734] or Mashino [US 2003/0073299] in view of in view Sachem Spec Sheet 379, as submitted by IDS.**

Farnworth et al and Mashino substantially discloses the claimed method including etching silicon. Farnworth et al and Mashino do not expressly teach using the etch solution comprising approximate 6%TMAH and approximate 94% propylene glycol for etching silicon. However, selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) "Reading a list and

Art Unit: 2813

selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig-saw puzzle." 325 U.S. at 335, 65 USPQ at 301. See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960) (selection of a known plastic to make a container of a type made of plastics prior to the invention was held to be obvious). It would have been obvious for those skilled in the art to use the claimed etch solution as taught by SaChem in the process of Farnworth et al or Mashino as a known etchant for removing/etching silicon.

**12. Claims 65-66 are rejected under 35 U.S.C. 103(a) as being unpatentable over Farnworth et al [US 2004/0256734], Watkins et al [US 2005/0077913] or Mashino [US 2003/0073299] in view of Takehiko et al [JP 06-041770].**

Farnworth et al, Watkins et al and Mashino substantially discloses the claimed method except using the second etch solution comprising ammonium fluoride, phosphorous acid, water, hydrogen peroxide and at least one organic solvent.

However, Takehiko et al disclose the second etch solution comprising ammonium fluoride, phosphorous acid, water, hydrogen peroxide and at least one organic solvent for cleaning silicon.

Therefore, at the time of invention, it would have been obvious for those skilled in the art to modify process of Farnworth et al, Watkins et al or Mashino by using the second etch solution comprising ammonium fluoride, phosphorous acid, water, hydrogen peroxide and at least one organic solvent for cleaning silicon substrate to provide a smooth silicon surface without contaminant.

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanhha Pham whose telephone number is (571) 272-1696. The examiner can normally be reached on Monday and Thursday 9:00AM - 9:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, consisting of several loops and a final horizontal stroke.

Thanhha Pham